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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/603,461

06/25/2003

Timothy Henson

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EXAMINER

LANDAU, MATTHEW C

ART UNIT

PAPER NUMBER

2815

DATE MAILED: 07/22/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/603,461

Applicant(s)

HENSON, TIMOTHY

Examiner

Matthew Landau

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 25 June 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date ____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: ____.

DETAILED ACTION

Drawings

Figures 1 and 2 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawing sheets are required in reply to the Office action to avoid abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Figures 5-9 are objected to because the shading renders the drawings illegible.

The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the limitation "said substrate is a semiconductive material of the same conductivity type as said epitaxial layer, but of a lower conductivity" must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. The

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replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-20 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 1 and 10 recite the limitation "said plurality of contact regions". There is insufficient antecedent basis for this limitation in the claims.

Claim 15 recites the limitation "said second contact". There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this

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subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1, 2, 4, 5, 8-11, 14, and 17-20 are rejected under 35 U.S.C. 102(b) as being anticipated by Hshieh et al. (US Pat. 5,929,481, hereinafter Hshieh'481).

In regards to claim 1, Figure 2 of Hshieh'481 discloses a MOSgated semiconductor device comprising: a channel receiving region 54 of a first conductivity type (n-type); a channel region 56 of a second conductivity type formed in said channel receiving region; a plurality of spaced trenches (col. 3, lines 23-26) formed in said channel receiving region; a first region 70 of a first conductivity type formed at the bottom of each trench, each said first region of said first conductivity type being adjacent to said channel receiving region and of a higher conductivity than said channel receiving region; a plurality of conductive regions 58 of said first conductivity type each disposed adjacent a trench; and a contact layer 76 formed over said channel receiving region and in ohmic contact with said plurality of contact regions (portions of channel region 56 in contact with the contact layer 76).

In regard to claims 2 and 11, Figure 2 of Hshieh'481 discloses field relief regions 57 of said second conductivity type formed below said channel region.

In regards to claim 4, Figure 2 of Hshieh'481 discloses the channel receiving region 54 is an epitaxial layer of semiconductor material (col. 3, lines 55-60) formed over a substrate 50.

In regards to claims 5 and 14, Figure 2 of Hshieh'481 discloses a second (drain) contact 80 formed over said substrate.

In regards to claim 8, Hshieh'481 discloses said conductive regions 58 are source regions (col. 4, lines 15-17).

In regards to claims 9 and 17, Figure 2 of Hshieh'481 discloses each trench is filled with a conductive material 64 and lined at each side wall with a gate insulation material 62.

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In regards to claim 10, Figure 2 of Hshieh'481 discloses a MOSgated semiconductor device comprising: a semiconductor die having an epitaxial layer 54 of a first conductivity type formed over a substrate 50; a channel region 56 of a second conductivity type formed in said epitaxial layer; a plurality of spaced trenches (col. 3, lines 23-26) formed in said epitaxial layer; a first region 70 of a first conductivity type formed at the bottom of each trench, each said first region of said first conductivity type being adjacent to said epitaxial layer and of a higher conductivity than said epitaxial layer; a plurality of source regions 58 of said first conductivity type each disposed adjacent a trench; and a source contact 76 formed over said epitaxial layer and in ohmic contact with said plurality of contact regions.

In regards to claim 18, Hshieh'481 discloses the conductive material is polysilicon and said gate insulation material is oxide (col. 4, lines 5-10).

In regards to claims 19 and 20, Figure 2 of Hshieh'481 discloses said trenches extend to a depth below said channel region 56.

Claims 1, 4, 5, 8-10, 14, and 17-20 are rejected under 35 U.S.C. 102(e) as being anticipated by Hshieh et al. (US Pat. 6,657,254, hereinafter Hshieh'254).

In regards to claims 1 and 8, Figure 2 of Hshieh'254 discloses a MOSgated semiconductor device comprising: a channel receiving region 202 of a first conductivity type (n-type); a channel region 204 of a second conductivity type formed in said channel receiving region; a plurality of spaced trenches formed in said channel receiving region; a first region 206 of a first conductivity type formed at the bottom of each trench, each said first region of said first conductivity type being adjacent to said channel receiving region and of a higher conductivity than said channel receiving region; a plurality of conductive regions 212 (source regions) of said

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first conductivity type each disposed adjacent a trench; and a contact layer 218 formed over said channel receiving region and in ohmic contact with said plurality of contact regions (portions of channel region 204 in contact with the contact layer 218).

In regards to claim 4, Hshieh'254 discloses said channel receiving region 202 is an epitaxial layer of semiconductive material formed over a substrate 200 (col. 4, lines 18-26).

In regards to claims 5 and 14, Hshieh'254 discloses a second contact (drain contact) formed over said substrate (col. 5, lines 3 and 4).

In regards to claims 9, 17, and 18, Figure 2 of Hshieh'254 discloses each trench is filled with a conductive material 211 (polysilicon) and lined at each side wall with a gate insulation material 210 (silicon oxide) (col. 4, lines 36-41).

In regards to claim 10, Figure 2 of Hshieh'254 discloses a MOSgated semiconductor device comprising: a semiconductor die having an epitaxial layer 202 of a first conductivity type formed over a substrate 200; a channel region 204 of a second conductivity type formed in said epitaxial layer; a plurality of spaced trenches formed in said epitaxial layer; a first region 206 of a first conductivity type formed at the bottom of each trench, each said first region of said first conductivity type being adjacent to said epitaxial layer and of a higher conductivity than said epitaxial layer; a plurality of source regions 212 of said first conductivity type each disposed adjacent a trench; and a source contact 218 formed over said epitaxial layer and in ohmic contact with said plurality of contact regions.

In regards to claims 19 and 20, Figure 2 of Hshieh'254 discloses said trenches extend to a depth below said channel region 204.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-3 and 10-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yang (US Pat. 5,442,214) in view of Hshieh (US Pat. 6,262,453, hereinafter Hshieh'453).

In regards to claim 1, Figure 2I of Yang discloses a MOSgated semiconductor device comprising: a channel receiving region 32 of a first conductivity type (n-type); a channel region (portion of layer 35 directly source region 36 and immediately adjacent the trench) of a second conductivity type formed in said channel receiving region; a trench formed in said channel receiving region; a first region 39 of a first conductivity type formed at the bottom of each trench, each said first region of said first conductivity type being adjacent to said channel receiving region and of a higher conductivity than said channel receiving region (col. 4, lines 15-25); a plurality of conductive regions 36 of said first conductivity type each disposed adjacent a trench; and a contact layer (not labeled) formed over said channel receiving region and in ohmic contact with said plurality of contact regions (portions of region 36 in contact with the contact layer). The difference between Yang and the claimed invention is a plurality of trenches. Figure 2A of Hshieh'453 discloses a semiconductor device with a plurality of trenches. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to modify the invention of Yang by having a plurality of trenches for the purpose of obtaining a power device (i.e., increasing the capacity).

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In regards to claim 10, Figure 2l of Yang discloses a MOSgated semiconductor device comprising: a semiconductor die having an epitaxial layer 32 of a first conductivity type formed over a substrate 31; a channel region (portion of layer 35 directly source region 36 and immediately adjacent the trench) of a second conductivity type formed in said epitaxial layer; a trench formed in said epitaxial layer; a first region 39 of a first conductivity type formed at the bottom of each trench, each said first region of said first conductivity type being adjacent to said epitaxial layer and of a higher conductivity than said epitaxial layer; a plurality of source regions 36 of said first conductivity type each disposed adjacent a trench; and a source contact (not labeled) formed over said epitaxial layer and in ohmic contact with said plurality of contact regions. The difference between Yang and the claimed invention is a plurality of trenches. Figure 2A of Hshieh'453 discloses a semiconductor device with a plurality of trenches. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to modify the invention of Yang by having a plurality of trenches for the purpose of obtaining a power device (i.e., increasing the capacity).

In regards to claims 2 and 11, Figure 2l of Yang discloses field relief regions 34 of said second conductivity type formed below said channel region.

In regards to claims 3 and 12, Figure 2l of Yang discloses said field relief regions are spaced from said channel region. As mentioned above, it is considered the channel region consists of only the portion of region 35 that is adjacent the trench and directly below region 36. Therefore, it can be considered the field relief regions 34 are spaced from the channel region.

Claims 7 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hshieh'481 in view of Hshieh'453.

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In regards to claims 7 and 16, the difference between Hshieh'481 and the claimed invention is high conductivity contact regions of said second conductivity type formed in said channel region and in ohmic contact with said contact layer. Figure 2A of Hshieh'453 discloses a trench gate MOS device with a high conductivity contact region 160, with the same conductivity type as the channel region 130. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to modify the invention of Hshieh'481 by using the channel contact regions of Hshieh'453 for the purpose of reducing the contact resistance (col. 6, lines 55-58 of Hshieh'453).

Claims 6 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hshieh'481 in view of Standing et al. (US PGPub 2001/0048116, hereinafter Standing).

In regards to claims 6 and 15, the difference between Hshieh'481 and the claimed invention is the second contact is a trimetal contact. Figures 1 and 2 of Standing disclose a semiconductor device with a trimetal drain contact 34. In view of such teaching, it would have been obvious to the ordinary artisan at the time the invention was made to modify the invention of Hshieh'481 by using a trimetal drain contact for the purpose of utilizing a contact material that is easily solderable or otherwise electrically connectable to a wide area contact surface (i.e., low resistance) (paragraph [0004] of Standing).

Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hsieh'481.

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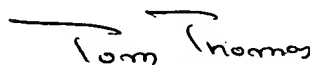
It would have been obvious to the ordinary artisan at the time the invention was made to modify the invention of Hshieh'481 by using a substrate of lower conductivity than the overlying epitaxial layer. This type of configuration is well-known in the art.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew C. Landau whose telephone number is (571) 272-1731.

The examiner can normally be reached from 8:30 AM - 5:30 PM. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (571) 272-1664. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9306 for regular communications and (703) 872-9306 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.



TOM THOMAS
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800

Matthew C. Landau

Examiner

July 16, 2004